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FOREST PEST MANAGEMENT

3430 BIOLOGICAL EVALUATION
R2-83-4

WESTERN SPRUCE BUDWORM
IN THE
ROCKY MOUNTAIN REGION
1983

United States
Department of
Agriculture

Forest Service

Forest Pest Management
Denver, Colorado

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WESTERN SPRUCE BUDWORM IN THE ROCKY MOUNTAIN REGION 1983

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ABSTRACT

In 1983, the western spruce budworm defoliated approximately 2,617,000 acres of forest in Colorado and 133,000 acres in Wyoming. Defoliation severity in most of Colorado and Wyoming was moderate.

Branch samples for the budworm egg mass and defoliation survey were collected from the same areas sampled in 1982 and from a few additional areas on the Arapaho, San Isabel and San Juan National Forests. In Colorado, survey results indicate that egg mass densities have increased significantly from 1982 levels. Moderate to heavy defoliation is predicted for 1984 in all areas sampled except the San Isabel National Forest where only light defoliation is expected. In Wyoming, egg mass densities have declined drastically from 1982 levels but moderate to heavy defoliation is still expected next summer.

INTRODUCTION

The western spruce budworm, Choristoneura occidentalis Freeman, is the most serious defoliator in the Rocky Mountain Region. In this region, the insect feeds primarily on Douglas-fir and true firs and occasionally on Engelmann spruce and other tree species. The budworm larvae feed primarily in buds and on foliage of the current year. They also feed within the cones of host trees significantly reducing the reproductive ability of infested trees.

Defoliation becomes most noticeable early in summer when the remains of recently chewed needles cause the trees to appear reddish-brown. Significant tree damage occurs after several consecutive years of defoliation. Stands infested for several years assume a gray appearance as a result of the continued defoliation, tree topkill, and mortality.

Budworm outbreaks occur periodically and may last from five to fifteen years in the Rocky Mountain Region. Intervals between outbreaks have varied from a few years to several decades. Outbreaks have occurred along the Colorado Front Range from 1935 to 1945 and from 1957 to 1962. The current outbreak appears to have begun in 1974.

The population dynamics of the budworm are not fully understood. It is believed that harvesting methods and effective prevention and control of fires since the 1920's resulted in the development of dense stands with a higher percentage of shade-tolerant, climax tree species favorable to the budworm. Natural biological factors such as parasites and pathogens do not appear to be important in regulating rising western spruce budworm populations. Unfavorable weather, particularly late spring frosts, has had the most dramtic effect on budworm populations in the West (Klein 1967, Fellin et al. 1972, McKnight 1971). Collapse of budworm outbreaks along the northern Front Range of Colorado in 1945 and on the Shoshone National Forest in 1936 followed late spring frosts which decimated the budworm populations (McKnight 1967, Lister 1969).

Forest Pest Management monitors the western spruce budworm through annual aerial detection and egg mass surveys. Annual surveys are conducted to provide concerned land managers with information about extent, intensity and predictions of budworm population trends within the Region.

This year branch samples were collected from the same permanent plots sampled in 1982. In addition, a few new areas on the Arapaho, San Juan and San Isabel National Forests were sampled to obtain a better indication of the budworm situations on these forests.

BIOLOGY OF THE WESTERN SPRUCE BUDWORM

The western spruce budworm has one generation per year in Colorado. The adult budworm is a small, mottled, gray to reddish-brown moth which appears bell-shaped when motionless. During July and early August, moths can be observed flying about the crowns of host trees.

Shortly after mating, females deposit eggs in masses attached to the undersides of needles of host trees. Within days, the eggs hatch. The newly hatched larvae do not feed. Instead, they disperse to seek protective overwintering sites such as under bark scales, in twig crotches or among lichens. Once in these sites, the larvae spin silken shelters and hibernate.

In the spring, larvae disperse from their shelters to the foliage where they mine old needles for one to two weeks. As the buds begin to expand, larvae move onto and consume the new foliage. Mature larvae are a little over an inch long, brown to olive in color, with whitish dots on the top side of each segment. Older larvae construct a feeding niche by spinning webs between shoots. By early July, larvae transform to an inactive pupal stage within the feeding webs and adults emerge from the pupae within several days.

EXTENT OF THE OUTBREAK

In 1983, aerial surveys indicated approximately 2.75 million acres were infested in the Rocky Mountain Region (Figure 1). Budworm infested acreage in the area is displayed in Table 1.

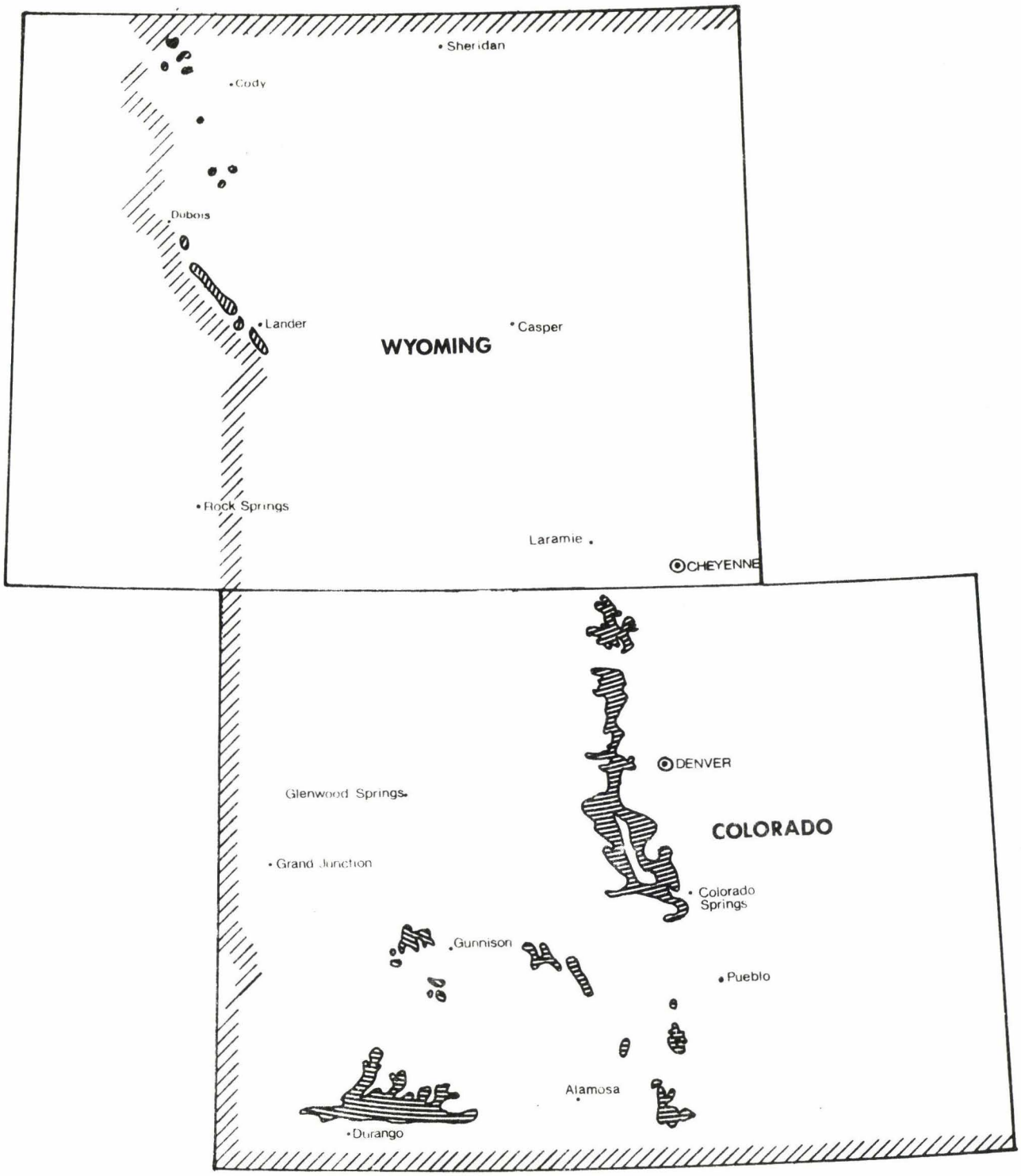


Figure 1--Western spruce budworm defoliation in the Rocky Mountain Region, 1983.

Table 1. 1983 Western Spruce Budworm Defoliation Acreage by Land Ownership Class 1/

	National Forest	Other Federal	State	Private	Total
Arapaho	43,344	3,277	7,117	97,742	151,480
Gunnison	33,693	17,040	1,527	4,218	56,478
Pike	605,116	20,342	11,913	277,724	915,095
Rio Grande	19,760	670	0	28	20,458
Roosevelt	286,020	14,510	11,145	157,085	468,760
San Isabel	93,932	6,789	0	38,729	139,450
San Juan	553,867	125,734	6,575	179,142	865,318
Shoshone	31,502	84,738	0	17,032	133,272
TOTAL	1,667,234	273,100	38,277	771,700	2,750,311

1/ Acreage defoliated by budworm was determined from aerial sketch maps made at the time of peak defoliation.

The current outbreak began along the northern Front Range of Colorado in 1974. Since then, the area defoliated by this insect has expanded to the southern Front Range and the southwestern portion of the state. In 1983, the budworm defoliated more than 2.6 million acres in Colorado - the largest area of defoliation ever recorded for the state. The budworm now infests almost all of the Douglas-fir and white fir types in the state and is expanding further into the mixed conifer areas. Most of the top-kill and total tree mortality caused by this insect occurs along the northern Front Range where defoliation has occurred each year for the last 9 years. In this area, Douglas-fir bark beetle, Dendroctonus pseudotsugae Hopkins, populations appear to be increasing in stands that have been severely affected by the budworm.

In Wyoming, the area defoliated by the budworm has decreased during the last two years from 182,000 acres in 1982 (Raimo 1982) to 133,000 acres in 1983. Much of the decrease occurred in the northern portion of the state-west of Cody. The budworm infestation west of Lander continues to occur along the eastern foothills of the Wind River Range.

EVALUATION METHODS

Egg mass density is used to monitor spruce budworm trends, evaluate long term effects of control projects and to forecast defoliation. Annual defoliation predictions are based on the density of new egg masses on branch samples collected from the midcrown of the host trees (Carolin and Coulter, 1959, 1972).

Egg mass density and defoliation surveys were made during August and September after the egg deposition period. Branch samples were collected from the same areas sampled in 1982 and from a few additional areas on the Arapaho, San Isabel and San Juan National Forests. Table 2 shows the names and locations of the areas sampled in 1983.

The sampling procedures previously used to determine egg mass densities were changed this year to increase precision. Previously, our plots consisted of three dominant or co-dominant host trees. From each tree, two 24-inch branches were pruned from the mid-crown for a total of six branches per plot.

This year we adopted a sample design proposed by Schmid and Farrar (1982). Schmid and Farrar found that differences among branches within the same crown level of a tree do not contribute significant variation to egg mass counts, so only one branch needs to be removed from the mid-crown. They found, however, that differences among trees contribute a significant amount of variation, so the number of sample trees should be as large as possible.

Therefore, this year, each plot consisted of six dominant or co-dominant host trees within close proximity. Only trees of one species were sampled at each plot. One 12-inch branch was pruned from the midcrown of each tree for a total of six branches per plot. The foliage samples were bagged, labeled, and transported to the laboratory, where new egg mass densities were determined. A stereoscope was used to separate new from old egg masses.

Egg mass density classes and associated defoliation are displayed in Table 3. These classes are adopted from McKnight (1970) and were refined by Linnane (1979) based on four years of data from the fixed plot, cluster tree, sampling scheme.

Estimates of the current year defoliation levels were made from the egg mass sample branches. For each sampling sight, the new growth on 25 randomly selected twigs was examined in the laboratory to determine the percentage of defoliation. Defoliation estimates are based on the percent of missing needles determined by an ocular examination of each twig.

Table 2. Locations of 1982 Egg Mass Sampling Plots

Forest	Plot Name	Location
Shoshone	Hunter Peak C.G.	T.57 N., R.106 W., Section 21
	Rocky Ford	T.56 N., R.106 W., Sections 1, 11, 14
	Camp Creek	T.56 N., R.105 W., Sections 10 & 14
	Badger Springs	T.56 N., R.105 W., Section 24
	Sinks Canyon	T.32 N., R.101 W., Sections 24 & 28
Roosevelt	Devils Gulch	T.5 N., R.72 W., Section 4
	Big Elk Meadows	T.3 N., R.72 W., Sections 1 & 11
		T.4 N., R.72 W., Section 36
	Magnolia Road	T.1 S., R.71 W., Sections 5 & 8
Pike	Ormes Peak	T.13 S., R.68 W., Sections 1 & 2
	Indian Creek	T.8 S., R.69 W., Sections 10 & 14
		T.8 S., R.70 W., Section 19
	Little Scraggy	T.8 S., R.71 W., Section 24
	Currant Creek	T.15 S., R.73 W., Section 15
San Isabel	Oak Creek P.G.	T.20 S., R.70 W., Section 19
	Balman Reservoir	T.46 N., R.12 E., Section 6
	Alvarado C.G.	T.23 S., R.73 W., Section 5
	Beulah	T.23 S., R.68 W., Sections 28 & 29
	Spring Creek	T.31 S., R.69 W., Section 4
	Music Pass	T.43 N., R.72 W., Section 32
San Juan	Blanco Basin	T.35 N., R.2 E., Section 30
	Columbine Lake	T.39 N., R.8 W., Section 31
	Wolf Creek C.G.	T.37 N., R.1 E., Section 16
	East Fork	T.36 N., R.1 E., Section 7
	Cimarrona C.G.	T.38 N., R.3 W., Section 8
	Pine River C.G.	T.37 N., R.6 W., Section 26
	Vallacito Reservoir	T.37 N., R.6 W., Section 16
		T.36 N., R.6 W., Section 8
	Old Timers C.G.	T.36 N., R.6 W., Section 20
	Transfer Park C.G.	T.37 N., R.7 W., Section 19
	Coon Creek	T.37 N., R.8 W., Section 33
	Haviland Lake C.G.	T.38 N., R.9 W., Section 25
	Missionary Ridge	T.37 N., R.8 W., Section 34
Gunnison	Soap Creek C.G.	T.50 N., R.4 W., Section 32
	Powderhorn	T.46 N., R.3 W., Section 1
	Commissary C.G.	T.50 N., R.4 W., Section 19
	Sapinero Mesa	T.47 N., R.3 W., Section 23

Table 3. Defoliation prediction classes for western spruce budworm egg mass sampling in Region 2.

Class	Mean Number of New Egg Masses Per Square Meter Foliage	Defoliation Prediction 1/
1	1.6 or less	Undetectable
2	1.7 to 10.0	Light
3	10.1 or more	Moderate to Heavy

1/ Defoliation expected on new growth only

Undetectable	0 - 10%
Light	10 - 35%
Moderate	35 - 65%
Heavy	65 - 100%

RESULTS

Arapaho National Forest: Aerial surveys indicated that approximately 151,480 acres were defoliated on National Forest and adjacent lands in 1983. The area of detectable defoliation increased significantly from the 1982 estimate of 35,491 acres. Egg mass density and defoliation data had not been collected on this Forest in several years. This year's data indicate that the area suffered moderate defoliation in 1983 and that moderate to heavy defoliation can be expected in 1984 (Table 4).

Table 4. Results of Western Spruce Budworm Egg Mass and Defoliation Survey on the Arapaho National Forest in 1983.

Area	Number of Branch Samples	1983 Defoliation Estimate	Mean Number of New Egg Masses per Square Meter Foliage	1984 Defoliation Prediction
Sprucedale	30	Moderate	40.4	Moderate to Heavy
Idaho Springs	30	Moderate	28.0	Moderate to Heavy
Summary	60	Moderate	34.1	Moderate to Heavy

Gunnison National Forest: About 56,478 acres were defoliated on National Forest and adjacent lands in 1983. This represents a 50% decline from the 1982 estimate of visible defoliation.

This year, two new samping sites - Sapinero Mesa and Commissary Campground were added to our survey in the Gunnison area. In 1983, defoliation was moderate in all of the areas. Egg mass densities are similar to those found in 1982 and moderate to heavy defolaition is predicted for 1984 (Table 5).

Table 5. Results of Western Spruce Budworm Egg Mass and Defoliation Survey on the Gunnsion National Forest in 1983.

Area	Number of Branch Samples	1983 Defoliation Estimate	Mean Number of New Egg Masses per Square Meter Foliage	1984 Defoliation Prediction
Soap Creek	30	Moderate	7.5	Light
Powderhorn	30	Moderate	20.0	Moderate to Heavy
Sapinero Mesa	30	Moderate	11.5	Moderate to Heavy
Commissary Campground	30	Moderate	9.5	Light
SUMMARY	120	Moderate	12.1	Moderate to Heavy

Pike National Forest: Aerial surveys indicate that approximately 915,095 acres were defoliated in 1983 on the Pike National Forest and adjacent lands. In 1982, about 669,698 acres were defoliated.

Four areas were sampled for egg mass density and defoliation severity data (Table 6). Defoliation was moderate in all four areas. Defoliation is expected to be moderate to heavy in each of the areas in 1984.

It is important to note that no new egg masses were found in the Ormes Peak area last year and that the average denisty was 38.3 egg masses per square meter of foliage in 1983.

Table 6. Results of Western Spruce Budworm Egg Mass and Defoliation Survey on the Pike National Forest in 1983.

Area	Number of Branch Samples	1983 Defoliation Estimate	Mean Number of New Egg Masses per Square Meter Foliage	1984 Defoliation Prediction
Indian Creek	30	Moderate	17.6	Moderate to Heavy
Ormes Peak	30	Moderate	38.3	Moderate to Heavy
Little Scraggy	30	Moderate	36.3	Moderate to Heavy
Currant Creek	30	Moderate	49.2	Moderate to Heavy
SUMMARY	120	Moderate	35.4	Moderate to Heavy

Roosevelt National Forest: Three areas were sampled. Survey results are presented in Table 6. Approximately 468,760 acres were defoliated on National Forest and adjacent lands. This is a slight increase over the 419,559 acres of defoliation reported in 1982.

Defoliation severity increased to moderate levels at the Big Elk Meadows and Magnolia Road areas and remained light at Devil's Gulch.

Egg mass densities at all three sites also increased slightly in 1983. Defoliation should again be moderate to heavy at Big Elk Meadows and Magnolia Road in 1984 while light defoliation is again predicted at Devil's Gulch (Table 7).

Table 7. Results of Western Spruce Budworm Egg Mass and Defoliation Survey on the Roosevelt National Forest in 1983.

Area	Number of Branch Samples	1983 Defoliation Estimate	Mean Number of New Egg Masses per Square Meter Foliage	1984 Defoliation Prediction
Big Elk Meadows	30	Moderate	11.4	Moderate to Heavy
Magnolia Road	30	Moderate	16.5	Moderate to Heavy
Devil's Gulch	30	Light	2.5	Light
SUMMARY	90	Moderate	10.1	Moderate to Heavy

Rio Grande National Forest: Aerial surveys indicated that approximately 20,458 acres were defoliated on National Forest and adjacent lands in 1983. Most of the defoliation occurred east of Great Sand Dunes National Monument between Mosca Pass and Medano Pass. No egg mass density data was gathered from this area.

San Isabel National Forest: An aerial survey indicated approximately 139,450 acres of defoliation on both National Forest and adjacent lands in 1983. The area of detectable defoliation increased by about 70 percent over the 1982 estimate (Raimo 1982).

Results of the egg mass survey on the San Isabel National Forest are displayed in Table 8. Defoliation was moderate in all the trees except Alvarado Campground where it was estimated as light. Egg mass densities at Beulah, Alvarado Campground, and Music pass indicate that defoliation should be undetectable in 1984. Next year, Oak Creek Campground should have light defoliation while defoliation at Balman Reservoir, should again be moderate to heavy.

Table 8. Results of Western Spruce Budworm Egg Mass and Defoliation Survey on the San Isabel National Forest in 1983.

Area	Number of Branch Samples	1983 Defoliation Estimate	Mean Number of New Egg Masses per Square Meter Foliage	1984 Defoliation Prediction
Beulah	30	Moderate	1.5	Undetectable
Oak Creek Campground	30	Moderate	4.6	Light
Alvarado Campground	30	Light	.3	Undetectable
Balman Reservoir	30	Moderate	26.9	Moderate to Heavy
Music Pass	24	Moderate	0.0	Undetectable
SUMMARY	144	Moderate	6.7	Light

San Juan National Forest: Approximately 865,318 acres of defoliation were detected this year. This is a significant increase over the acreage reported in 1982 (Raimo 1982).

This year, two new sampling sites - Missionary Ridge and Columbine Lake were added to our survey in the San Juan area (Table 8). Defoliation was moderate in all areas sampled except Blanco basin where defoliation was only light. The potential for moderate to heavy defoliation in 1984 exists in all but four areas. Blanco Basin, Coon Creek, Pine River Campground and Wolf Creek Campground should experience only light defoliation next year (Table 9).

Table 9. Results of Western Spruce Budworm Egg Mass and Defoliation Survey on the San Juan National Forest in 1983.

Area	Number of Branch Samples	1983 Defoliation Estimate	Mean Number of New Egg Masses per Square Meter Foliage	1984 Defoliation Prediction
Blanco Basin	30	Light	4.7	Light
Cimarrona Campground	24	Moderate	14.3	Moderate to Heavy
Coon Creek	30	Moderate	2.7	Light
East Fork	30	Moderate	25.4	Moderate to Heavy
Haviland Lake Campground	30	Moderate	16.5	Moderate to Heavy
Pine River Campground	30	Moderate	6.9	Light
Transfer Park Campground	30	Moderate	11.0	Moderate to Heavy
Vallecito Reservoir	30	Moderate	24.4	Moderate to Heavy
Wolf Creek Campground	30	Moderate	2.7	Light
Old Timers Campground	30	Moderate	14.2	Moderate to Heavy
Missionary Ridge	30	Moderate	10.6	Moderate to Heavy
Columbine Lake	30	Moderate	12.9	Moderate to Heavy
SUMMARY		Moderate	12.2	Moderate to Heavy

Shoshone National Forest: Between 1982 and 1983 the area of visible defoliation decreased by 40 percent. In 1983, approximately 133,272 acres of defoliation were detected.

In 1983, five areas were sampled (Table 10). Defoliation in each of the areas was moderate. Egg mass densities declined drastically in 1983. The most dramatic decline occurred at the Hunter Peak Campground where the mean egg mass density decline from 109.9 egg masses per square meter in 1982 to 5.9 egg masses per square meter in 1983. In spite of this decrease, egg mass densities Forest-wide remain high enough to cause moderate to heavy defoliation in 1984.

Table 10. Results of Western Spruce Budworm Egg Mass and Defoliation Survey on the Shoshone National Forest in 1983.

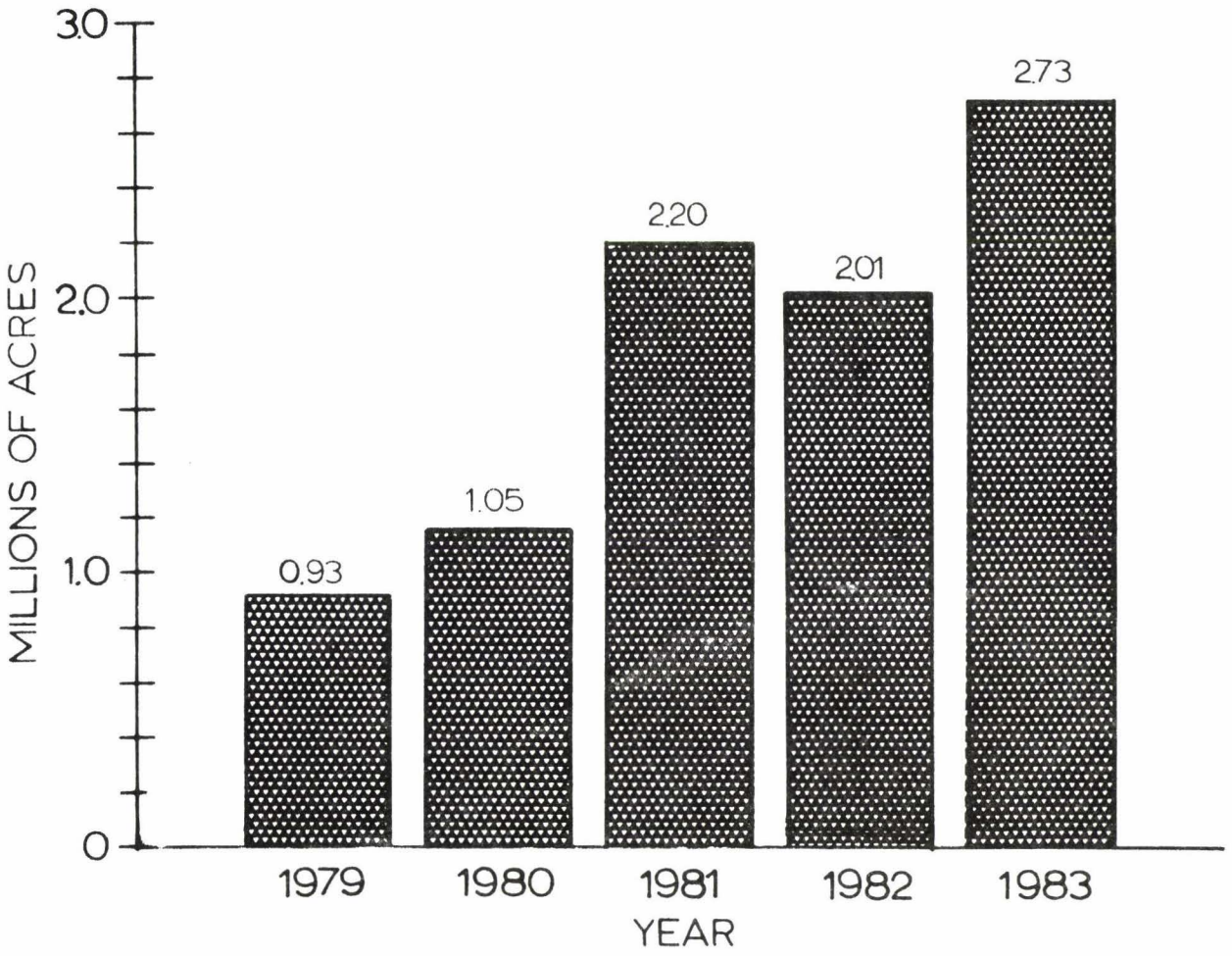
Area	Number of Branch Samples	1983 Defoliation Estimate	Mean Number of New Egg Masses per Square Meter Foliage	1984 Defoliation Prediction
Badger Spring	30	Moderate	7.4	Light
Hunger Peak Campground	30	Moderate	5.9	Light
Rocky Ford	30	Moderate	2.9	Light
Sinks Canyon	30	Moderate	24.7	Moderate to Heavy
SUMMARY	120	Moderate	10.2	Moderate to Heavy

SUMMARY

Figure 2 illustrates increases and declines in detectable defoliation from 1979 to 1983 in the Rocky Mountain Region.

Between 1982 and 1983, the area of detectable defoliation in the Region increased by about 37 percent (Table 11). Defoliation expanded in all but the Gunnison and Shoshone areas. The most significant increases occurred on the Pike, San Isabel, San Juan and Arapaho National Forests which experienced increases of 37, 69, 73, and 327 percent respectively. Defoliation severity throughout the Region generally remained at the moderate levels observed in 1982 with the exceptions of the Roosevelt and San Isabel areas which had light defoliation last year (Table 12).

Figure 2--Western spruce budworm defoliation in Region 2, 1979-1983.



The greatest increase in budworm activity occurred on the Arapaho and San Juan National Forest and adjacent lands. On the Arapaho National Forest, the area of detectable defoliation increased from 35,491 in 1982 to 151,480 acres in 1983. Much of this increase is attributed to a resurgence of budworm popluations and a resultant increase in defoliation intensity. Defoliation had occurred over much of the same area in 1982, but at a level that was detectable only by ground observation.

Egg mass densities generally remained static in all but two areas (Figure 3). A dramatic decrease in egg mass densities occurred at the sampling sites on the Shoshone National Forest where densities declined from 60.1 egg masses per square meter in 1982 to 10.1 egg masses per square meter in 1983. In contrast, a significant increase in egg mass densities occurred on the Pike National Forest. The average density on the Pike rose from 11.0 egg masses per square meter in 1982 to 35.4 egg masses per square meter in 1983.

Table 11. Acres of Western Spruce Budworm Defoliation in Region 2,[1/] by Forest, 1981-1983.

Forest	Acres Defoliated 1981	1982	1983
Arapaho	192,000	35,491	151,480
Gunnison	120,455	113,007	56,478
Pike	663,000	669,698	915,095
Rio Grande	0	0	20,458
Roosevelt	366,000	419,559	468,760
San Isabel	122,000	82,538	139,450
San Juan	570,000	500,834	865,318
Shoshone	130,000	182,054	133,372
Total	2,163,455	2,003,181	2,750,311

1/ Acreage defoliated by budworm was determined from aerial sketch maps made at the time of peak defoliation.

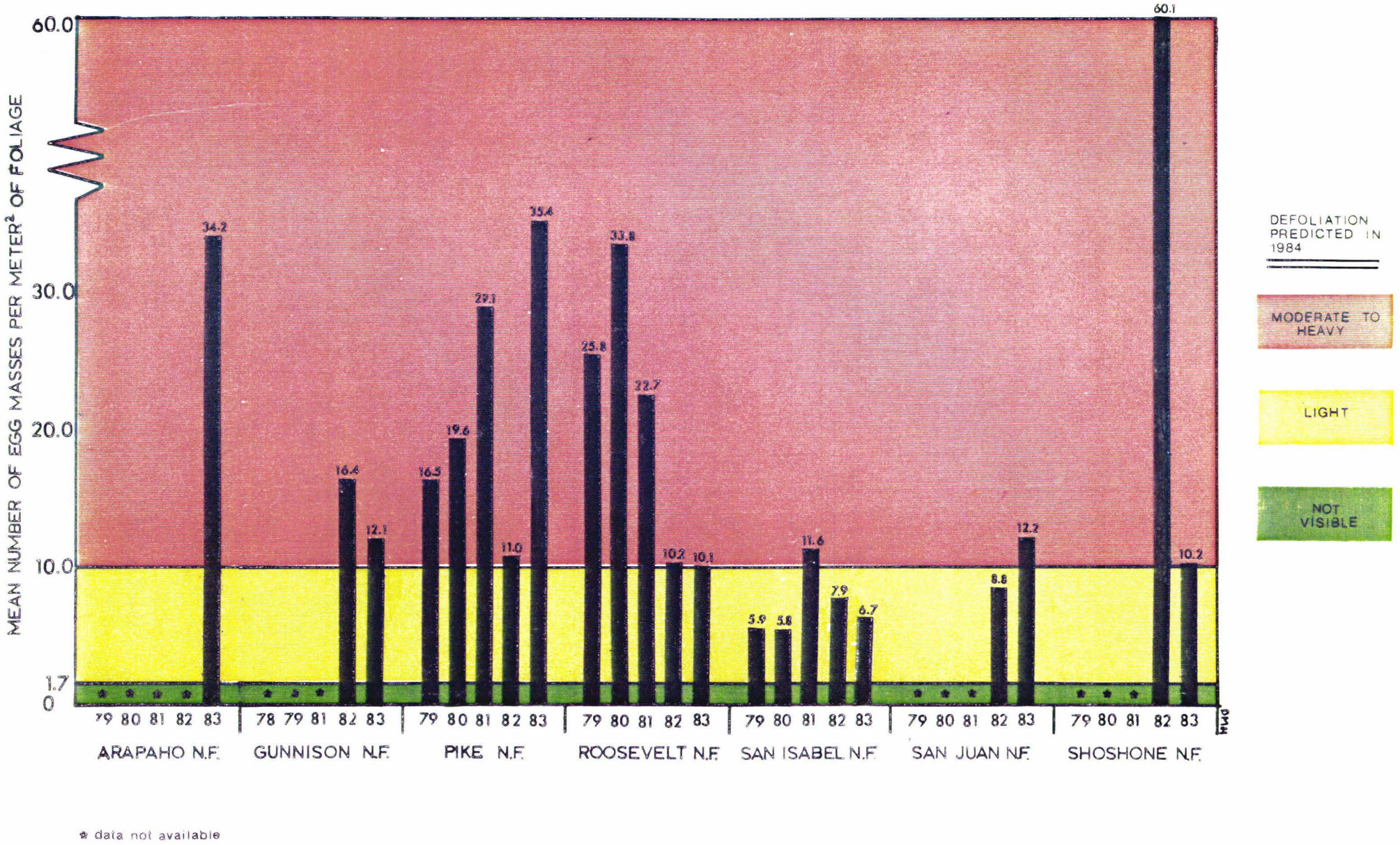
TABLE 12. Defoliation Severity In Region 2, 1979-1983

FOREST	1979		1980		1981		1982		1983	
	Predicted	Actual	Predicted	Actual	Predicted	Actual	Predicted	Actual	Predicted	Actual
	1/	2/	2/	3/	3/	4/	4/	5/	5/	
Arapaho	*	*	*	*	*	*	*	*	*	Mod
Gunnison	*	*	*	*	*	*	*	Mod	Mod to Heavy	Mod
Pike	Mod	Mod	Mod	Light to Mod	Mod to Heavy	Mod	Mod to Heavy	Light	Mod to Heavy	Mod
Roosevelt	Light	Mod	Mod	Mod	Mod to Heavy	Mod to Heavy	Mod to Heavy	Light	Mod to Heavy	Mod
San Isabel	Undetect	Light	Light	Light	Light	Light	Mod to Heavy	Light	Light	Mod
San Juan	Light	*	*	*	*	*	*	Mod	Light	Mod
Shoshone	*	*	*	*	*	*	*	Heavy	Mod Light	Mod

* Data not available

1/ Linnane (1978)
2/ Linnane (1979)
3/ Linnane (1980)
4/ Linnane (1981)
5/ Raimo (1982)

Figure 3--Results of the annual spruce budworm population survey, 1979-1983.



* data not available

ALTERNATIVE ACTIONS

An environmental assessment (EA), prepared in 1982, presented alternative strategies for dealing with the current western spruce budworm outbreak in the Rocky Mountain Region and the environmental consequences of those strategies (USDA Forest Service, 1982). The EA identified separate sets of alternatives for undeveloped forest lands and developed forest lands (Appendix A).

The recommendations and assumptions made in the 1982 EA continue to be valid.

RECOMMENDATIONS

The following actions were recommended in the EA for undeveloped and developed forest lands (Appendix B).

A. Undeveloped Forest Lands

For undeveloped forest lands, the alternative, Maintain Current Management is recommended. Although this alternative will result in losses of esthetic and timber values, these losses are judged acceptable based on public opinion, economic evaluation, and current USDA Forest Service policies and objectives.

B. Developed Forest Lands

For developed forest lands, the alternative, Protection of Individual High Value Trees with Insecticides, is recommended because it has little environmental risk, is technically effective, and the least costly suppression strategy.

Forest Supervisors should pay particular attention to developed recreation areas where treatment may be warranted. Rationale for these recommendations are found in the 1982 EA.

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APPENDIX A

from: *"Environmental Assessment - The Western Spruce Budworm in the Rocky Mountain Region" (USDA Forest Service, 1982)*

ALTERNATIVES

A. ALTERNATIVE FORMULATION

In developing alternatives, the following were considered:

1. Public comments on WSB.
2. Biological evaluations and damage surveys conducted on the WSB in the Colorado Front Range.
3. The degree of development and management objectives associated with the affected forest type.
4. The controversies surrounding pesticide spraying.
5. The history of WSB in Region 2 as it relates to the present situation.
6. The historical record of budworm activity and treatment described in other areas of North America.
7. Current WSB suppression strategies used in other Regions.
8. Federal, State, and local laws relating to the WSB situation.
9. USDA Forest Service policies and plans effected by the WSB.

During the formulation of alternatives, it became apparent that the degree of forest development and use by people was a significant factor in the level of concern for WSB. Therefore, the affected forest type was segregated into developed and undeveloped for purposes of identifying alternative courses of action. Developed forest land is characterized as campgrounds, administrative sites and critical near and middleground view zones. Undeveloped forest land comprises the area that does not fall under the description for developed forest land.

B. ALTERNATIVES FOR UNDEVELOPED FOREST LANDS

Undeveloped forest lands are general forest zones not meeting the developed forest criteria.

1. Maintain Current Management

This is the no action alternative. Under this alternative, the WSB outbreak will continue dependent on natural factors. WSB populations will

eventually collapse as a result of a combination of natural factors including: (1) starvation, (2) unfavorable weather, (3) disease, and (4) predation and parasitism. The outbreak will produce both adverse and beneficial effects which will be accepted.

Mitigation measures are as follows:

a. Conduct salvage and fuelwood sales where feasible.

2. Silvicultural Management

Where opportunities exist, silvicultural prescriptions will be designed to enhance stand quality. These prescriptions include: (1) thinning from above to reduce host tree density and favor non-host tree species, (2) shelterwood seed cuts with artifical regeneration of non-host tree species, (3) patch clearcuts with artifical regeneration of non-host tree species, and (4) salvage of damaged stands.

Migitation measures are as follows:

a. Conduct silvicultural management within the regional guidelines.

3. Direct Suppression with Aerial Applications of Chemical Insecticides

A timely aerial application of a chemical insecticide will protect foliage from defoliation and reduce tree damages. The application would be carefully timed to WSB development (i.e., 20% of the larvae in the 5th instar) to ensure maximum effectiveness with a minimal insecticide dose. Results from prior suppression projects in other Regions indicate more than one insecticide application may be required to achieve protection during the outbreak period. The exception to this experience occurred in New Mexico where a low population level, young outbreak was treated in 1977. This treatment provided protection for four years.

Insecticides registered for use against the WSB follow:

a. Carbaryl (carbamate insecticide). The Sevin-4-Oil® formulation of carbaryl has given consistently satisfactory results in reducing budworm numbers. Carbaryl is a nonpersistent pesticide available for general public use. No lasting adverse environmental effects have been identified at the registered, one pound of active ingredient per acre, dosage rate. Bees and wasps exposed to this insecticide suffer high rates of mortality.

b. Acephate (organophosphate insecticide). Orthene® is a non-persistent insecticide registered for use against the WSB and other forest defoliators. At the registered dosage rate of one-half pound active ingredient per acre, no adverse environmental effects have been observed.

c. Malathion (organophosphate insecticide). Malathion is a non-persistent, broad spectrum insecticide, registered for use against numerous insect pests. When applied against the WSB, previous results have not been consistent.

Mitigation measures are as follows:

a. Establish buffer zones where no spraying will take place. Buffer zones will include areas adjacent to streams creeks, lakes, and non-participating ownerships.

A more comprehensive discussion on the pesticides is found in Appendix C (of the EA or not included here).

4. Direct Suppression with Aerial Applications of Microbial Insecticides

The microbial insecticide, *Bacillus thuringiensis,* may protect foliage from defoliation, although results from applications elsewhere have been somewhat erratic. *Bacillus thuringiensis* or B.t. is a naturally occurring bacterium. It is a specific insecticide for a relatively few insect species. B.t. has no demonstrable effect on non-target organisms. The formulations Dipel® and thuricide® are registered for use against the WSB. More information on B.t. is found in Appendix C (not included).

C. ALTERNATIVES FOR DEVELOPED FOREST LANDS

Developed forest lands include improved campsites and recreation facilities, administrative sites, and critical near and middleground view zones.

1. Maintain Current Management

This is the no action alternative. It calls for no special action against the WSB. The insect outbreak will eventually collapse as a result of natural factors. Resulting tree damage would be accepted.

2. Silvicultural Management

This alternative is identical to silvicultural management for undeveloped lands.

3. Protection of Individual High Value Trees with Insecticides

Individual or small groups of high value trees, such as those in developed recreation sites, can be protected from defoliation by an application of either chemical or microbial insecticides. Insecticides would be applied with power hydraulic sprayers. The insecticides carbaryl, acephate, and B.t. mentioned in the Aerial Application Alternatives are registered for use with this type of equipment.

This strategy will protect treated trees; however, annual applications will be required during the outbreak period to achieve this objective.

Mitigation measures are essentially the same as the previous aerial application alternatives.

4. Direct Suppression with Aerial Applications of Chemical Insecticides

This alternative is identical to the Direst Suppression with Aerial Applications of Chemical Insecticides on Undeveloped Forest Lands.

5. Direct Suppression with Aerial Applications of Microbial Insecticides

This alternative is identical to Direct Suppresion with aerial Applications of Microbial Insecticides on Undeveloped Lands.

In addition, a biological control alternative using parasites and predators was considered, but dismissed because of insufficient information on efficacy and implementation.

APPENDIX B

from "Environmental Assessment - The Western Spruce Budworm in the Rocky Mountain Region" (USDA Forest Service, 1982)

DECISION NOTICE
and
FINDING OF NO SIGNIFICANT IMPACT

The Western Spruce Budworm in the Rocky Mountain Region

USDA Forest Service
Rocky Mountain Region

An environmental assessment discussing alternative strategies for use against the the western spruce budworm is available for public review in the Forest Service, Regional Office, Lakewood, Colorado. The western spruce budworm infestation includes lands with diverse management objectives and ownership patterns in Colorado and Wyoming. It is unlikely a single strategy will meet the needs of these various situations. As a result, the environmental assessment discloses alternatives in undeveloped forest lands and in developed forest lands which will apply to the majority of situations.

For undeveloped forest lands, it is my decision to adopt the alternative, Maintain Current Management. This alternative will result in losses of esthetic and timber values. These losses are judged acceptable based on public opinion, economic evaluation, and current USDA Forest Service policies and objectives. The alternative, Silvicultural Management, was not adopted because of lack of supporting research, little hope for immediate results, costs, and the magnitude of the strategy. Although there are indications certain silvicultural prescriptions may reduce budworm damage, no conclusive studies have yet been completed. Also, the prospect of treating large acreages to lessen susceptibility to budworm damage presents immense time and manpower requirements which are unrealistic to consider until silvicultural prescriptions are validated. Direct Suppression Alternatives with Aerial Applications of either Chemical or Microbial Insecticides, were not adopted because of concerns over effectiveness in suppressing WSB, high cost of alternatives, and public opinion of aerial insecticide spraying.

For developed forest lands, it is my decision to adopt the alternative, Protection of Individual High Value Trees with Insecticides. This alternative has little environmental risk, is technically effective, and the least costly of any of the suppression strategies. The Maintain Current Management alternative was not adopted because trees contribute significantly to the quality of the recreational experience in campgrounds and other high density recreation use areas. The Direct Suppression Alternatives with Aerial Applications of Insecticides were not adopted because of concerns over effectiveness in suppressing WSB, high cost of alternatives, and public opinion of aerial insecticide spraying.

Exceptions to this decision may be allowed, where private landowners, at their cost, wish to spray, by aerial or ground application, National Forest System lands that immediately border a spraying project on private lands. Approval for spraying that falls under this exception will be made on a case-by-case basis.

I have determined this action would not significantly affect the quality of the human environment. Therefore, an environmental impact statement is not needed. This determination was made considering the following factors: (a) the damage caused by the western spruce budworm will not significantly impact resource commitments; (b) local economies and employment will not be adversely affected; and (c) pesticide applications limited to individual trees, and to buffer strips adjacent to private lands, will not constitute an environmental hazard.

This decision is subject to administrative review pursuant to 36 CFR 211.19. A notice of appeal must be filed within 45 days from the date of this decision, or within 30 days of the date of receipt of the decision by persons entitled to notification of the decision under 36 CFR 211.19(d)(1). Notice of appeal must be in writing and submitted to the Regional Forester, USDA Forest Service, Rocky Mountain Region.

Craig W Rupp

CRAIG W. RUPP
Regional Forester

Date 5/28/82